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ABSTRACT

A study involving 716 male and 1,113 female first-year students admitted to the University of Delaware in the fall of 1985 was conducted to investigate the differential performance of men and women on the mathematics section of the Scholastic Aptitude Test (SAT). Data collected included SAT math scores; gender; and number of years of high school mathematics, physics, and computer science courses taken by the students. To investigate the effect of the number of years of coursework, unstandardized regressions were estimated. Results indicate that approximately 25% of the difference between men and women on SAT math scores is due to the difference between sexes in the number of years that mathematics, computer science, and physics courses were taken. The remaining approximately 75% difference between SAT math scores of men and of women is due to differences between sexes not investigated in this study. A further study is recommended that would control for math curriculum and student grades to determine whether other variables (such as sex-role socialization, item bias, and academic self-concept) are involved in the score differences. Three data tables are included. (TJH)

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WHY DO WOMEN HAVE LOWER AVERAGE SAT-MATH SCORES THAN MEN?

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Introduction

Men on average have higher SAT-Math scores than women. From 1966 to 1976, the gap between men's and women's scores varied between 41 and 51 points. After 1976, it has remained almost the same. Thus, in 1986 this difference was 50 points (Rosser et al, 1987) and in 1987, the national average score was 500 for men and 453 for women.

The gender differences in mathematical performance appear to arise during the high school years. For example, Plake et al. (1981) found that neither third grade nor sixth grade boys and girls differed significantly in mathematical performance on the Iowa Test of Basic Skills. Alexander and Pallas (1982) concluded that "female quantitative performance is not noticeably inferior to that of males at the beginning of high school . . . but we find a decided female disadvantage at the end of high school" (p. 12). However, this study shows that women who take courses in math during high school obtain higher grades in these courses than men.

Why this sex difference occurs is essentially unknown. Katzman et al. (1988) found that women suffer higher levels of anxiety than men while taking the SAT, and that some SAT-M items are biased against women (some of these items contain overtly masculine verbal content). Alternatively, the sex-role socialization of women may prevent a high level of quantitative and analytic accomplishment which makes them avoid quantitative activities (Fennema and Sherman 1977). Thus, for instance Gross (1988) has found that girls generally receive less encouragement at home and at school to pursue

math because technological fields are perceived as being primarily for men.

One aspect of gender difference is that women take fewer quantitative courses in high school than men (Alexander and Pallas, 1982). Once students start high school, they select courses according to their aptitudes and job perspectives. What is yet to be established, however, is how much this different pattern of coursework can explain womens' lower SAT math scores. This study attempts to determine whether the womens' SAT-M performance is lower than mens' performance because women take fewer years in mathematics, physics and computer science during high school.

Method

This study was conducted with freshmen who were admitted to the University of Delaware in the fall of 1985. Of the 2963 freshmen admitted (1199 men and 1764 women), 716 men and 1113 women had complete data on the following relevant five variables.

1. SAT math scores. Each student had his or her SAT math score reported by ETS when submitting the admission form to the University. SAT math scores range from 200 to 800.
2. Gender of students, coded 1 for male and 0 for female.
3. Number of years of math taken by the students during high school.
4. Number of years of physics taken by students during high school.
5. Number of years of computer science taken by the students during high school. The above three variables were self-report data taken

from the Cooperative Institutional Research Program survey (CIRP) administered to all the entering freshmen[1] and coded as follows:

CIRP Questionnaire Interpretation	Code
none	0
less than one academic year	0.5
1 year	1.0
2 years	2.0
3 years	3.0
4 years	4.0
5 or more years	5.0

Results

The means and the standard deviations for SAT math as well as number of years taken in math, physics, and computer science, are presented for both sexes in Table 1. Men have significantly higher means on all variables.

To investigate how much mens' coursework explains these higher SAT-Math scores, two unstandardized regressions were estimated. In the first equation, SAT-Math scores were regressed on gender plus the mathematics, physics and computer science variables. This equation constitutes the full model. In the second equation, SAT-Math scores were regressed on mathematics, physics and computer science variables. This equation constitutes the reduced model (see Table 2). A partial F test was conducted in order to test the

[1]The CIRP freshman survey was given to University of Delaware freshmen in the fall semester of 1985. Over the past 21 years some 1300 institutions in 49 states, the District of Columbia and Puerto Rico, and more than 6 million students have participated in the CIRP freshman survey. This questionnaire includes information about demographic characteristics, attitudes, values, life goals, career aspirations, expectations of college, experience in high school, and intended college major.

following hypothesis. After adjusting the difference of the number of years that men and women have taken in math, physics and computer science, there is a statistically significant difference in the SAT-Math scores of men and women.

The partial F (1, 1824) = 91.79 $p < .01$ was statistically significant. This result indicates that part of the difference in SAT-Math scores is due to the fact that men have taken more years in math, physics and computer science. The partial t test for each of the independent variables was statistically significant for the full model as for the reduced model. (See Table 2).

Another approach to explain the course-work hypothesis was tried out in an attempt to visualize the sensitivity of SAT-Math scores to the number of years taken in the three areas. Two unstandardized regression equations were estimated. In the first equation (see Table 3), the SAT-Math scores were regressed on gender. This constitutes the baseline equation. It tests the hypothesis of the difference in SAT-Math scores. In the second equation SAT math scores were regressed on gender plus the mathematics, physics and computer science variables. This second equation gives the size of the sex difference with mathematics, physics, and computer science controlled. The degree to which the sex difference is reduced from the first equation to the second equation represents the SAT math difference between men and women that can be accounted for by the difference between sexes in number of years of mathematics, physics and computer courses in high school.

The proportion of this change is:

$$\frac{51.59 - 38.2}{51.59} \times 100 = 25.95\%$$

One can observe that the SAT-math scores are responsive to the variations in the number of years taken in these three quantitative courses. The R^2 of the second equation is .16614 which represents an increment of 8.26% relative to the baseline equation (see Table 3). The difference between the two R^2 was statistically significant F (1,1825) = 180.778 p <.05.

In summary, this part of the study shows that around 25% of the difference between men and women in the SAT math scores is due to the difference between sexes in the number of years taken in mathematics, physics and computer science. The remaining 75% difference between SAT math scores of men and women is due to differences between sexes not investigated in this study.

Discussion

This study supports the coursework differential hypothesis proposed by Alexander and Pallas (1982), and also the Gross (1988) study in Montgomery County (Maryland). Gross found that students who had completed Algebra II scored 70 points higher than those whose last course was geometry; those who had completed trigonometry did 70 points better than the Algebra II students.

In the Alexander and Pallas study (1982), the 60 percent difference between men and women in their SAT-math scores was due to the differences between sexes in the number of courses taken in different quantitative subjects while in high school. Their

percentage is quite high compared to the results of this study (25%). However, Alexander and Pallas controlled 5 variables in the baseline equation while this study in the baseline equation only controlled the variable gender. Besides, in the second equation, Alexander and Pallas controlled 16 quantitative courses whereas this study, in the same equation has only controlled 3 quantitative courses.

Thus, the 60% of the sex difference in SAT-Math score is not only the result of sex difference in quantitative courses taken by students, but also the result of controlling other variables such as educational level of the father, educational level of the mother, race and scores on the School and College Aptitude Test in its quantitative components (SCATQ).

The present study shows that 25% of the sex difference in the SAT-Math scores is due exclusively to the course-work hypothesis. 75% of this difference remains unexplained in this study. However I suggest a further study of course-work hypothesis where the math curriculum and the students' grades in those courses are controlled. If after controlling these two variables, the sex-difference in SAT-Math still appears, then we could conclude that other variables such as sex-role socialization of women, bias in SAT-Math items, self-academic concept in math, among other factors, could account for the remaining 75% of sex-difference in the SAT-M scores.

Table 1

Means, Standard Deviations, and t-values

Variables	Gender	Mean	Standard Deviation	t-test values	P
SAT-M	men	576.89	88.57	12.62	.000
	women	525.30	80.01		
No. of yrs. of math	men	4.0	.48	6.79	.000
	women	3.8	.60		
No. of yrs. of physics	men	2.3	1.06	8.09	.000
	women	1.9	.96		
No. of yrs. of computer science	men	0.9	.87	9.08	.000
	women	0.6	.60		

All t values differ statistically at p < 0.01

N = 716 males and 1113 females

Table 2

Regression Equations

Equation 1 (Full Model)

SAT-M = 38.20 (Gender) + 34.42 (No. of years of Math)
+ 7.90 (No. of years of Physics) + 12.97 (No
of years of computer science) + 369.00 + e

R^2 = .16614

SSE (Sum Square of Error) = 11581025.74

Equation 2 (Reduced Model)

SAT-M = 37.51 (No. of years of Math) +
10.60 (No of years of Physics) + 17.74 (No.
of years of computer science) + 362.46

R^2 = .12417

SSE (Sum Square of Error) = 12163874.78

Partial F (1,1824) = 91.79 $p < .01$

t test for each of B's was statistically significant $p < .01$ in both equations

Table 3

Regression Equations

Equation 1 (base-line equation)

SAT-M = 51.59 (Gender) + 525.30 + e

R^2 = .08352

Equation 2

SAT-M = 38.20 (Gender) + 38.42 (No. of years of Math)
+ 7.90 (No. of years of Physics) + 12.97 (No
of years of computer science)+ 369.00 + e

R^2 = .16614

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